

TURBULENCE AND GLOBAL PROPERTIES OF THE SOLAR WIND

The solar wind shows striking characteristics that suggest that it is a turbulent magnetofluid, but the picture is not altogether simple. From the earliest observations, a strong correlation between magnetic fluctuations and plasma velocity fluctuations was noted. The high correlations suggest that the fluctuations are Alfvén waves. In addition, the power spectrum of the magnetic fluctuation showed evidence of an inertial range that resembled that seen in fully-developed fluid turbulence. Alfvén waves, however, are exact solutions of the equations of incompressible magnetohydrodynamics. Thus, there was a puzzle: how can a magnetofluid consisting of Alfvén waves be turbulent? The answer lay in the role of velocity shears in the solar wind that could drive turbulent evolution. Puzzles remain: for example, the power spectrum of the velocity fluctuations is less steep than the slope of the magnetic fluctuations. The plasma in the magnetic tail of Earth's magnetosphere also shows aspects of turbulence, as does the plasma in the dayside magnetosphere near the poles—the dayside cusps. Recently, new analyses of high time resolution magnetic field data from Cluster have offered a glimpse of how turbulence is dissipated, thus heating the ambient plasma.